

Bruce E. Cohen

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EDUCATION

1989 – 1996 Ph.D., University of California Berkeley, Department of Chemistry
1996 Neurobiology Course, Marine Biological Laboratory, Woods Hole, MA
1985 – 1989 A.B., Princeton University, *cum laude*, Department of Chemistry

RESEARCH POSITIONS

2011 – Career Staff Scientist, Biological Nanostructures Laboratory, The Molecular Foundry, Lawrence Berkeley National Laboratory
2005 – 2011 Staff Scientist, Biological Nanostructures Laboratory, The Molecular Foundry, Lawrence Berkeley National Laboratory
1997 – 2005 Postdoctoral fellow, University of California San Francisco
Advisor: Lily Y. Jan, Howard Hughes Medical Institute and Department of Physiology
1990 – 1996 Graduate research, University of California Berkeley
Advisor: Daniel E. Koshland, Jr., Department of Molecular and Cell Biology
1987 – 1989 Undergraduate research, Princeton University
Department of Chemistry

SELECTED PUBLICATIONS

MB Prigozhin, PC Maurer, AM Curtis, N Liu, MD Wisser, C Siefe, B Tian, EM Chan, G Song, S Fischer, S Aloni, DF Ogletree, ES Barnard, L-M Joubert, J Rao, AP Alivisatos, RM Macfarlane, **BE Cohen**, Y Cui, JA Dionne & S Chu. Bright sub-20 nm cathodoluminescent nanoprobe for electron microscopy. *Nature Nanotechnology* 14, 420 (2019).

A Teitelboim, B Tian, D Garfield, A Fernandez-Bravo, A Gotlin, PJ Schuck*, **BE Cohen*** & EM Chan*. Energy Transfer Networks Within Upconverting Nanoparticles are Complex Systems with Collective, Robust, and History-dependent Dynamics. *J. Phys. Chem. C* 123, 2678 (2019).

M Charrier, D Li, VR Mann, L Yun, S Jani, B Rad, **BE Cohen**, PD Ashby, K Ryan, CM Ajo-Franklin. Engineering the S-layer of *Caulobacter crescentus* as a Foundation for Stable, High-Density, 2D Living Materials. *ACS Synthetic Biology* 8, 181 (2019).

B Tian, A Fernandez-Bravo, H Najafiaghdam, NA Torquato, MVP Altoe, A Teitelboim, CA Tajon, Y Tian, NJ Borys, ES Barnard, M Anwar, EM Chan*, PJ Schuck* & **BE Cohen***. Low irradiance multiphoton imaging with alloyed lanthanide nanocrystals. *Nature Communications* 9, 3082 (2018).

H Najafiaghdam, EP Papageorgiou, NA Torquato, CA Tajon, H Zhang, C Park, B Boser, **BE Cohen** & M Anwar. A Molecular Imaging “Skin”: Time-resolving Intraoperative Imager for Microscopic Residual Cancer Detection Using Enhanced Upconverting Nanoparticles. *Proceedings of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 1-4 (2018).

CA Tajon, H Yang, B Tian, Y Tian, P Ercius, PJ Schuck, EM Chan & **BE Cohen**. Photostable and efficient upconverting nanocrystal-based chemical sensors. *Optical Materials* 84, 345-353 (2018).

M Chamanzar, DJ Garfield, J Iafrati, EM Chan, V Sohal, **BE Cohen**, PJ Schuck & MM Maharbiz.

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Upconverting nanoparticle micro-lightbulbs designed for deep tissue optical stimulation and imaging. *Biomedical Optics Express* 9, 4359-4371 (2018).

A. Fernandez-Bravo, K. Yao, ES Barnard, NJ. Borys, ES Levy, B Tian, CA Tajon, L Moretti, MVP Altoe, S Aloni, K Beketayev, F Scotognella, **BE Cohen***, EM Chan* & PJ Schuck*. Continuous-wave upconverting nanoparticle microlasers. *Nature Nanotechnology* 13, 572-577 (2018).

DJ Garfield, NJ Borys, SM Hamed, NA Torquato, CA Tajon, B Tian, B Shevitski, ES Barnard, YD Suh, S Aloni, JB Neaton, EM Chan*, **BE Cohen*** & PJ Schuck*. Enrichment of molecular antenna triplets amplifies upconverting nanoparticle emission. *Nature Photonics* 12, 402-407 (2018).

VR Mann, AS Powers, DC Tilley, JT Sack & **BE Cohen**. Azide-Alkyne Click Conjugation on Quantum Dots by Selective Copper Coordination. *ACS Nano* 12, 4469-4477 (2018).

N Sugiyam, AY Sonay, R Tussiwand, **BE Cohen** & P Pantazis. Effective Labeling of Primary Somatic Stem Cells with BaTiO₃ Nanocrystals for Second Harmonic Generation Imaging. *Small* 14: 1870036 (2018).

SM Wichner, VR Mann, AS Powers, MA Segal, M Mir, JN Bandaria, MA DeWitt, X Darzacq, A Yildiz & **BE Cohen**. Covalent Protein Labeling and Improved Single Molecule Optical Properties of Aqueous CdSe/CdS Quantum Dots. *ACS Nano* 11, 6773-6781 (2017).

ME Materia, MP Leal, M Scotto, PB Balakrishnan, SA Kumar, ML García-Martín, **BE Cohen**, EM Chan & T Pellegrino. Multifunctional Magnetic and Upconverting Nanobeads as Dual Modal Imaging Tools. *Bioconjugate Chemistry* 28, 2707-27 (2017).

ES Levy, CA Tajon, TS Bischof, J Iafrati, A Fernandez-Bravo, DJ Garfield, M Chamanzar, MM Maharbiz, VS Sohal, PJ Schuck, **BE Cohen** & EM Chan. Energy-Looping Nanoparticles: Harnessing Excited-State Absorption for Deep-Tissue Imaging. *ACS Nano* 10, 8423-8433 (2016).

EM Chan, ES Levy & **BE Cohen**. Rationally designed energy transfer in upconverting nanoparticles. *Advanced Materials* 27, 5753-5761 (2015).

EL Rosen, K Gilmore, AM Sawvel, AT Hammack, SE Doris, S Aloni, V Altoe, D Nordlund, T Weng, D Sokaras, **BE Cohen**, JJ Urban, DF Ogletree, DJ Milliron, D Prendergast & BA Helms. Chemically directing *d*-block heterometallics to nanocrystal surfaces as molecular beacons of surface structure. *Chemical Science* 6, 6295-6304 (2015).

DC Tilley, KE Eum, S Fletcher-Taylor, DC Austin, C Dupré, LA Patrón, RL Garcia, K Lam, V Yarov-Yarovoy, **BE Cohen** & JT Sack. Chemoselective tarantula toxins report voltage activation of wild-type ion channels in live cells. *Proc. Natl. Acad. Sci.* 111, E4789-E4796 (2014).

DJ Gargas, EM Chan, AD Ostrowski, S Aloni, V Altoe, ES Barnard, B Sani, JJ Urban, DJ Milliron, **BE Cohen*** & PJ Schuck*. Engineering bright sub-10-nm upconverting nanocrystals for single-molecule imaging. *Nature Nanotechnology* 9, 300-305 (2014).

EM Chan, G Han, JD Goldberg, DJ Gargas, AD Ostrowski, PJ Schuck, **BE Cohen** & DJ Milliron. Combinatorial discovery of lanthanide-doped nanocrystals with spectrally pure upconverted emission. *Nano Lett.* 12, 3839-3845 (2012).

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AE Albers, EM Chan, PM McBride, CM Ajo-Franklin, **BE Cohen*** & BA Helms*. Dual-emitting quantum dot/quantum rod-based nanothermometers with enhanced response and sensitivity in live cells. *J. Am. Chem. Soc.* 134, 9565–9568 (2012).

AD Ostrowski, EM Chan, DJ Gargas, EM Katz, G Han, PJ Schuck, DJ Milliron & **BE Cohen**. Controlled synthesis and single-particle imaging of bright, sub-10 nm lanthanide-doped upconverting nanocrystals. *ACS Nano* 6, 2686–2692 (2012).

SB Lowe, JAB Dick, **BE Cohen** & MM Stevens. Multiplex sensing of protease and kinase enzyme activity *via* orthogonal coupling of quantum dot–peptide conjugates. *ACS Nano* 6, 851–857 (2012).

H Lia, S Wang, AY Chuang, **BE Cohen** & H-H Chuang. Activity-dependent targeting of TRPV1 with a pore-permeating capsaicin analog. *Proc. Natl. Acad. Sci.* 108, 8497–8500 (2011).

MA Caldwell, AE Albers, SC Levy, TE Pick, **BE Cohen**, BA Helms & DJ Milliron. Driving oxygen coordinated ligand exchange at nanocrystal surfaces using trialkylsilylated Chalcogenides. *Chem. Comm.* 47, 556–558 (2011).

BE Cohen. Biological Imaging: Beyond fluorescence. *Nature* 467, 407–408 (2010).

AR Bayles, HS Chahal, DS Chahal, CP Goldbeck, **BE Cohen** & BA Helms. Rapid cytosolic delivery of luminescent nanocrystals in live cells with endosome-disrupting polymer colloids. *Nano Lett.* 10, 4086–4092 (2010).

JE Ghadiali, **BE Cohen*** & MM Stevens*. Protein kinase-actuated resonance energy transfer in quantum dot–peptide conjugates. *ACS Nano* 4, 4915–4919 (2010).

E Chan, C Xu, A Mao, G Han, J Owen, **BE Cohen** & DJ Milliron. Reproducible, high-throughput synthesis of colloidal nanocrystals for optimization in multidimensional parameter space. *Nano Lett.* 10, 1874–1885 (2010).

S Wu, G Han, DJ Milliron, S Aloni, V Altoe, DV Talapin, **BE Cohen*** & PJ Schuck*. Non-blinking and photostable upconverted luminescence from single lanthanide-doped nanocrystals. *Proc. Natl. Acad. Sci.* 106, 10917–10921 (2009).

G Han, T Mokari, C Ajo-Franklin & **BE Cohen**. Caged quantum dots. *J. Am. Chem. Soc.* 130, 15811–15813 (2008).

JS Salafsky & **BE Cohen**. A second-harmonic-active unnatural amino acid as a structural probe of biomolecules on surfaces. *J. Phys. Chem. B* 112, 15103–15107 (2008).

P Abbyad, X Shi, W Childs, TB McAnaney, **BE Cohen** & SG. Boxer. Measurement of solvation responses at multiple sites in a globular protein. *J. Phys. Chem. B* 111, 8269–8276 (2007).

BE Cohen*, A Pralle, X Yao, G Swaminath, C Gandhi, YN Jan, BK Kobilka, EY Isacoff & LY Jan. A fluorescent probe designed for studying protein conformational change. *Proc. Natl. Acad. Sci.* 102, 965–970 (2005).

BE Cohen*, TB McAnaney, ES Park, YN Jan, SG Boxer & LY Jan. Probing protein electrostatics with a synthetic fluorescent amino acid. *Science* 296, 1700–1703 (2002).

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(*denotes corresponding authors)

SELECTED PRESENTATIONS (PREVIOUS 3 YEARS)

SNAP and Click: Improved strategies for bioconjugation to quantum dots (keynote talk). European Materials Research Society 2019 Spring Meeting, Nice, France, May 27-31, 2019.

Alloyed upconverting nanoparticles for multiphoton imaging and lasing at ultralow fluences. Materials Research Society Spring Meeting, Phoenix, April 22-26, 2019.

Mining the far reaches of the periodic table for bioimaging probes: non-blinking, non-bleaching inorganic nanocrystals (keynote talk). Southern California Society for Microscopy and Microanalysis 2019 Spring Symposium, University of California, Irvine, April 12, 2019.

Alloyed upconverting nanoparticles for multiphoton imaging and lasing at ultralow powers. American Chemical Society Spring 2019 National Meeting, Orlando, March 31-April 4, 2019.

Challenging the polymer barricades around quantum dots: keeping copper ions away from the surface during click reactions. American Chemical Society Spring 2019 National Meeting, Orlando, March 31-April 4, 2019.

Near-Infrared Nanocrystals for Imaging Cells with Minimal Phototoxicity, 25th International Molecular Med Tri-Con, San Francisco, March 10-15, 2019.

Low fluence multiphoton imaging with alloyed lanthanide nanocrystals, American Chemical Society Spring 2018 National Meeting, New Orleans, April 18-23, 2018.

Fine control of the chemistry in and on luminescent nanocrystals, Department of Chemistry seminar, University of California Davis, April 2, 2018.

Low fluence multiphoton imaging with alloyed lanthanide nanocrystals, 15th Annual Advanced Imaging Methods Workshop, Berkeley, CA, January 24-26, 2018.

Low Fluence Multiphoton Imaging with Alloyed Lanthanide Nanocrystals, Glenn T. Seaborg Center Seminar, Lawrence Berkeley National Laboratory, January 10, 2018.

Alloyed lanthanide-doped nanocrystals for low-fluence multiphoton imaging, SHIFT 2017: International Conference on Spectral Shaping for Biomedical and Energy Applications, Tenerife, Spain, November 13-17, 2017.

Characterization of dynamic Kv channel-toxin structures with voltage clamp spectroscopy. Emerging Concepts in Ion Channel Biophysics, Mexico City, Mexico, October 10-13, 2017.

Alloyed lanthanide-doped nanocrystals for low-fluence multiphoton imaging, American Chemical Society 253rd National Meeting, April 2-5, 2017.

The quantum dots we've always wanted, 14th Annual Advanced Imaging Methods Workshop, Berkeley, CA, January 25-27, 2017.

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Exceptionally efficient lanthanide-doped nanocrystals designed for low-fluence single-particle imaging, Materials Research Society Fall Meeting, Boston, MA, November 27-December 2, 2016.

Improved single-molecule optical properties and covalent protein labeling of compact CdSe/CdS quantum dots, International Conference on Fundamental Processes in Semiconductor Nanocrystals, Berlin, Germany, September 5-6, 2016.

PATENTS AND DISCLOSURES

Cohen, Bruce E.; Ostrowski, Alexis; Chan, Emory M.; Gargas, Daniel; Katz, Elan; Schuck, P. James; Milliron, Delia J. Controlled Synthesis of Bright and Compatible Lanthanide-Doped Upconverting Nanocrystals. U.S. Patent No. 9556379 (2017).

B.E. Cohen, D.E. Koshland, Jr. Caged NADP and NAD. U.S. Patent 6020480 (2000).

RESEARCH SUPPORT

Ongoing

The Molecular Foundry Neaton (PI) ongoing
Department of Energy
DE-AC02-05CH11231

This block grant is the core budget for the Molecular Foundry, covering certain internal research and User program expenses for all Principal Investigators throughout the institute.

Role: Co-Investigator

Visualizing endogenous ion channel activation Cohen, Sack (co-PIs) 9/1/16-8/31/20
National Institutes of Health
NINDS R01

A project to develop probes able to record the activities of specific ion channels during neuronal activity by conjugating novel state-dependent toxins to fluorophores and nanocrystals.

Role: co-Principal Investigator

Multiscale Self-Assembly for Strong and Tough Living Materials Ajo-Franklin (PI) 4/1/17 – 3/31/21
Department of Defense
DARPA - ELM (Engineered Living Materials)

The goal of this project is to design, synthesize, assemble, and characterize nanoparticle-bacterial composites that resemble 'brick-and-mortar' structure of nacre, but that can switch between being porous and flexible to impermeable, stiff, and strong in response to environmental cues.

Role: co-Principal Investigator

Completed

Fiberless Deep-Brain Optical Imaging Cohen (PI) 10/1/14 – 9/30/16
Department of Energy
Laboratory-Directed Research and Development (LDRD)

A multi-disciplinary and multi-institution (LBNL, UC Berkeley, UCSF) project that combines expertise in optogenetics, optical probe design, nanoscience, and neuronal biochemistry, which will extend the reach of imaging and manipulation deep into the brain.

Role: Principal Investigator

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Nano-optogenetic control of neuronal firing with targeted nanocrystals Cohen (PI) 10/1/15-9/30/16
State of California
Cal-BRAIN Award

Part of a statewide program to support and integrate new technologies capable of monitoring wide-scale activity in the brain. The goal of this proposal is to develop nanocrystals that efficiently convert near infrared light to wavelengths that cause neurons to fire, and to test these for optogenetic activity.

Role: Principal Investigator

Neuro/Nano Technology for Brain Mapping Denes (PI) 10/1/13 – 9/30/14

Department of Energy

Laboratory-Directed Research and Development (LDRD)

The goal of this project was to integrate efforts related to the Presidential BRAIN initiative and begin to systematically address the technical challenges associated with high-resolution and large-scale neural technologies.

Role: Co-Investigator

Integrated Imaging of Microbial Community Response to External Threats Auer (PI) 10/1/12 – 9/30/14

Department of Energy

Laboratory-Directed Research and Development (LDRD)

An effort to gain fundamental insight into inter-species conflicts in microbial communities by integrating multiple imaging modalities.

Role: Co-Investigator